HIGH-K ISOMERS AND ROTATIONAL STRUCTURES IN ^{174}W

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The A≈180 mass region is fertile ground for the observation of high-K isomers, since both neutron and proton high-Ω orbitals lie near the Fermi surface. The decays from high-K states that involve a large change in the K quantum number are typically hindered, and the hindrance is expected to be especially robust for prolate γ-rigid rotors such as the Hf and W isotopes. The observation of a high-K isomer in ^{176}W [1] which decays anomalously fast through transitions involving a large change in K was therefore unexpected. One of the proposed mechanisms for the anomalous behavior is a tunneling of the nucleus from a potential energy minimum at γ=120^o, where the quasiparticle angular momentum is aligned along the symmetry axis in a high-K configuration to a prolate (γ=0^o) minimum, where the angular momentum is purely collective and aligned perpendicular to the symmetry axis.

In order to investigate the nature of these anomalous decays further, we have performed spectroscopic investigations of the neighboring even-even isotope ^{174}W, with the ^{128}Te(^{50}Ti,4n) reaction, using the Gammasphere array. In addition to isomeric structures, several new rotational bands have been observed and the previously known collective structures have been extended by about ten units of angular momentum. The yrast sequence has been extended upto the second band crossing.

We report the observation of a four quasiparticle $K^\pi = 12^+$, $t_{1/2}$=130(5) ns isomer in ^{174}W, which has strong K-violating, ΔK=12, decays to the ground state band. The major fraction of the decay goes to the ground state band, despite the availability of intermediate K=8 states. The hindrance factor calculated from gamma tunneling calculations [2] for this isomer seems to deviate significantly from expected systematics.

In addition to the K=12 isomer, a two quasiparticle K^π=8^- isomer has been observed. The half-life of this state is measured to be $t_{1/2}$=150(4) ns. The decay of this isomer is in marked contrast to that of the higher-lying isomer and occurs only to a K=5 band. The rotational bands built upon both these isomers have been identified to spins beyond 20 $\hbar$.

We have performed cranked Woods-Saxon calculations to understand the prompt rotational structures. The crossing frequencies determined from these calculations are in excellent agreement with the experimental observations. Total Routhian Surface calculations predict a well-deformed axially symmetric prolate shape for the yrast states upto high rotational frequencies. Configuration assignments for the various bands in ^{174}W have been made using the experimentally measured M1/E2 branching ratios, the results of the cranked Woods-Saxon calculations and comparison with the systematics in neighboring nuclei.

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[2] Y.R. Shimizu (private communication) and K. Narimatsu *et al.*, Nuclear Physics A**601**, 69(1996).